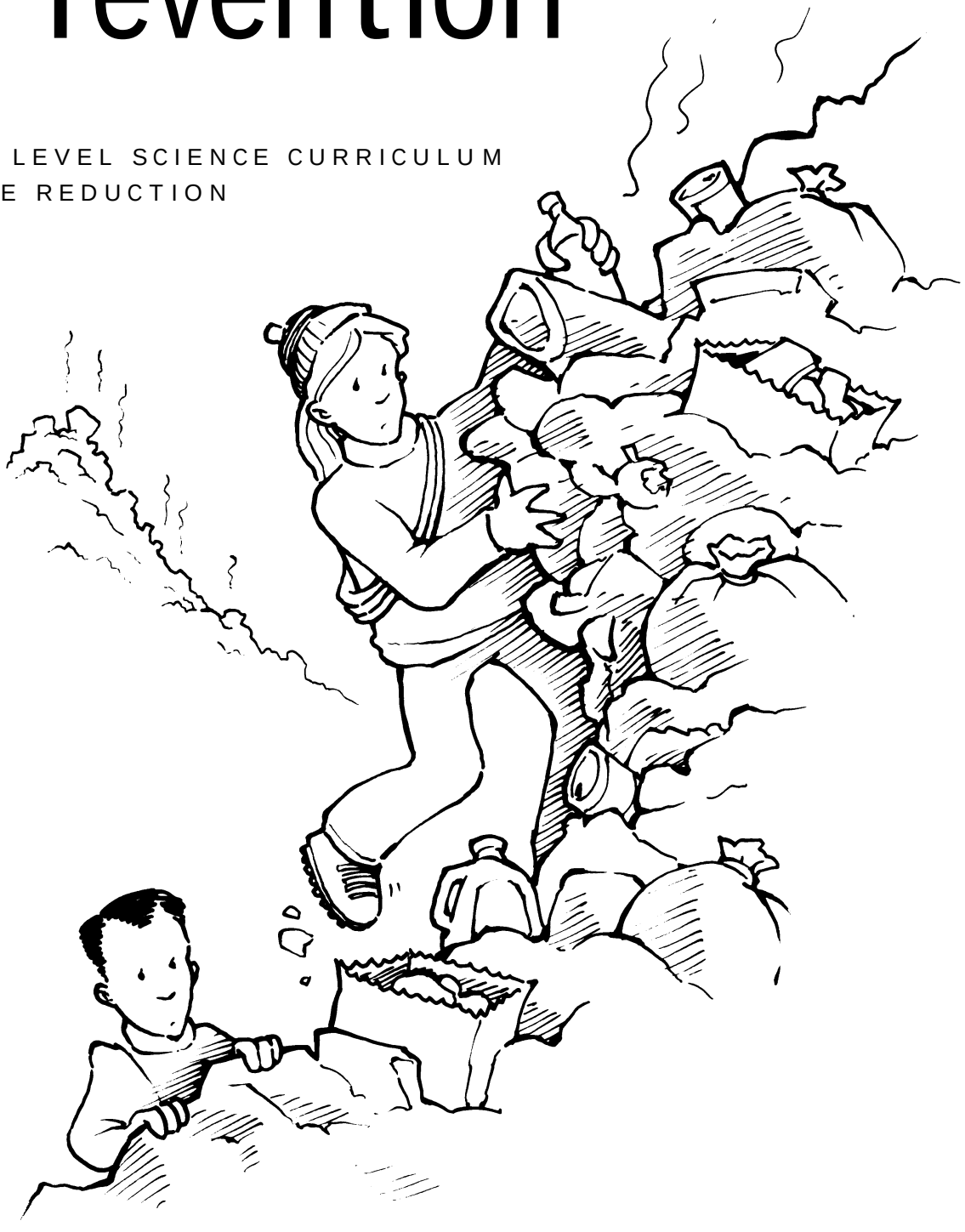
An Ounce of Prevention

A MIDDLE LEVEL SCIENCE CURRICULUM
ON SOURCE REDUCTION



NSTA

Forward

As a frequent digger and describer of landfills, I am acutely aware of the solid waste situation in America. I have seen firsthand what is in landfills, and what isn't in them. I have also seen their growth slowed very little by our after-the-fact waste reduction efforts. Let's face it: while recycling is valuable, creating less waste is even more important.

To be successful, waste management will have to become waste prevention. Waste prevention, in turn, will have to be based on a clear understanding of the underlying causes—social, behavioral, political and physical—of discards. As teachers, you and I are in a unique position to help with this effort. That's because the education of today's students, who are tomorrow's consumers, is one of the most effective ways to assure the switch from waste management to waste prevention.

This curriculum is an excellent way for you and your students to understand the need to prevent waste and use less stuff. By learning about the benefits of waste prevention and recycling, we will move farther down the road of the real journey that lies ahead—the conservation of resources for future generations of people, plants and animals.

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Acknowledgements

The National Science Teachers Association (NSTA) gratefully acknowledges the hard work of the following people and organizations, without whom this curriculum could not have been developed or completed.

- Crystal Lal, who organized, edited and managed the project for the NSTA;
- Pam Ashford, Page Keeley, Inez Liftig, Janet Peeler and Pat Warren are the dedicated teachers who wrote and edited the lessons;
- Pam Ashford, Deer Park, WA
  William Boone, Bloomington, IN
  Glyn Brice, Wenatchee, WA
  Charlene Czerniak, Toledo, OH
  Diane Hill, Florence, KY
  Page Keeley, Coopers Mills, ME
  Melinda Mills, Houston, TX
  Janet Peeler, Marietta, GA
  Suzanne Spradling, Oklahoma City, OK,
  our panel of beta-testers who used the activities in their classrooms and provided valuable suggestions for revisions;
- Dr. William Rathje of the University of Arizona, who acted as technical advisor;
- Bob Lilienfeld, editor of The ULS (Use Less Stuff) Report, who developed the "Ounce of Prevention" concept and oversaw final production;
- Tony Kingsbury, of The Dow Chemical Company, who acted as technical advisor and liaison to Dow.

We also wish to thank the Dow Chemical Company, which sponsored the development and production of *An Ounce of Prevention.*

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Contents

Curriculum Guide

I. Introduction

We all know how important it is to recycle. But let's stop and think about why we do it. It's to reduce waste, isn't it? Aren't we really trying to keep from throwing things away, thus conserving our precious resources?

Recycling is working, but it's only the first step.

From this perspective, we can begin to understand why recycling alone can't solve all of our solid waste problems. For instance, the U.S. Environmental Protection Agency (EPA) states that our national recycling rate is 22 percent. Many experts feel that we will never get past the 33 percent level. There is just too much stuff, and the cost to recycle more will probably be greater than what our society cares to spend.

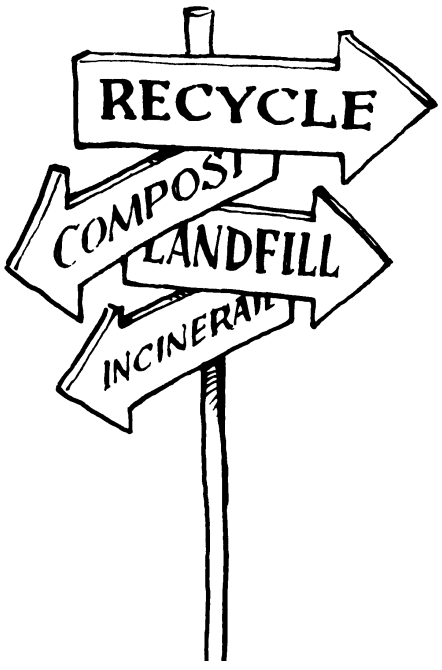
Also, recycling is a process like any other manufacturing process. It uses energy and creates both pollution and waste of its own. Recycling will create new jobs, but many will be moved from nonrecycling industries and others will be low-paying, low-skilled jobs such as collecting, sorting and transporting used materials.

What else should we be doing?

What can we do to ensure that our recycling efforts do the most good? Let's start by remembering three little words: *reduce, reuse* and *recycle.* Which one comes first? It's reduce. And it's first for a reason. It's better not to create waste than to have to figure out what to do with it. As Benjamin Franklin said, "*An ounce of prevention is worth a pound of cure.*"

Enter source reduction, or waste prevention.

Reducing is technically known as *source reduction.* It means minimizing the use of materials and energy so that we can save resources, reduce pollution and significantly cut down on the creation of toxic and hazardous waste. Eliminating waste in the first place is the real reason why reducing comes before recycling: reducing is proactive, while recycling is reactive.



How do source reduction and recycling compare?

An easy way to understand the difference between reducing and recycling is to think about brushing your teeth. If you are proactive and brush your teeth well, your visits to the dentist will be short, painless and inexpensive. But if you don't brush well, the dentist will have to fix your teeth by drilling out cavities. That's reactive, painful and expensive. Obviously, the better choice is not to have any cavities.

If you're like most people, this concept of source reduction is fairly new. But once you understand it, the merits are obvious. Your students are the same way: they know about the need to recycle, but need to learn about how to reduce waste. That's where this program can help.

What will my students learn?

The goals of this program are to:

1. Help students learn about the value of source reduction and its place in the hierarchy of solid waste solutions.
2. Provide a basis for students' thinking about the need to conserve all types of resources, including materials, energy, water and air.
3. Provide an interdisciplinary learning approach that fosters sound thinking and the development of good research techniques.
4. Enhance the learning and use of scientific skills, tools and concepts relevant to most middle school science curriculae.

II. How the Program Works

We've developed a series of six sections that present knowledge in a step-by-step fashion. Section 1 logically and thematically comes before Section 2, Section 2 precedes Section 3, and so on. At a minimum, try to use one activity from each section to ensure a logical flow of both information and learning.

Section 1 provides background information on garbage–where it comes from, its composition and patterns of change over the years. In Section 2, students will learn where garbage goes when it leaves their homes, and why it's so important to reduce. The concept of source reduction is introduced as well.

Section 3 tackles a big trash issue–packaging–which accounts for a third of household waste. By reducing the amount of packaging we use, we can make a big dent in the amount of garbage we produce. Students will learn how to reduce packaging, and find a few surprises along the way.

Section 4 discusses hazardous waste. Reducing the use of toxic materials around the home can help minimize water and ground contamination. Section 5 then begins to tie everything together by exploring the concept of Life Cycle Analysis, which studies the environmental effects of products and processes from a cradle-to-grave perspective.

Finally, it's your students' turn to test their knowledge and make a difference. Section 6 gives you a variety of hands-on projects designed to reduce waste at school and at home. We've included a Quiz you can use after finishing the lessons. You'll find it and the answer sheet on pages 15–18.

III. Overview

Section 1
Getting the Facts About Garbage

Let's start with a basic course in trash, so students understand how much garbage we create, where it comes from and where it goes.

Activity 1
A Big Waste Problem, No Matter How You Slice It

Students will learn what exactly goes into our trash. They will also discover differences between weight and volume, and be able to explain why these differences occur and what they mean.

Activity 2
Generations of Waste

As long as there have been people, there has been trash. But the composition of trash has changed as society has changed. In this lesson, students will go on "archaeological digs" to determine different living patterns in American societies over the last 300 years. The evidence for their findings? Garbage!

Activity 3
Today's Waste: What's in My Trash?

If students liked learning about the past from going through "old" garbage, there'll really enjoy investigating our society by analyzing their own trash. This activity works as an extension of the previous one or can be used as a stand-alone lesson.

Section 2
Introducing Source Reduction

If we're still creating garbage faster than we can figure out what to do with it, maybe it's time to create less trash.

Activity 4
Where Does the Trash Go?

Out of sight, out of mind. That's how we usually think (or don't think) about trash. In this lesson, students will learn about the four basic options for waste: composting, recycling, incineration and landfilling. At the end, they'll start thinking about ways to prevent or eliminate garbage, leading into the main topic of this curriculum—source reduction.

Activity 5
Island Survival

You're on an island with a few other people. There's only so much you can bring, and you can't leave anything behind when you leave. What's the best strategy to ensure your survival without creating too much waste? What does the ability to survive on an island say about our ability to survive on the Earth? This is a highly creative way to introduce the concept of source reduction.

Section 3
Producing Less Packaging

Packaging takes up a third of our municipal solid waste. How can we use less? Students will learn about ways to reduce packaging and discover that packages serve some very useful purposes.

Activity 6
Physical Properties of a Package

What is a package? What functions does it serve? Why are some light and others heavy? Some strong and others flimsy? Students will start thinking about why packages are the way they are, and get a feel for ways in which packaging can be reduced.

Activity 7
A Juicy Investigation
What's the most environmentally efficient way to serve orange juice? Fresh squeezed? In plastic containers? Glass bottles? The answer may surprise you and your class. This activity combines good critical thinking plus analytical skills to determine the best way to get one's fill of Florida (and California) sunshine.

Activity 8
Coffee Conundrum
What would the morning be without a cup of fresh-roast coffee, brewed right from the can? What about from a brick pack, instead? These new packages are not as recyclable as steel, but they are incredibly efficient in terms of energy and waste savings. The class will build on Activity 7 to learn ways to perform an in-depth environmental analysis. The winner? The most source-reduced package, of course.

Section 4
Reducing Hazardous Waste
Packaging isn't the only kind of waste we need to reduce. There are lots of hazardous wastes being dumped into the environment–many from our own homes. Reducing toxic waste is a large part of source reduction.

Activity 9
What's Hazardous about Household Products?
Did you know that EPA officials are more concerned about the hazardous waste in landfills than with the landfills themselves? Or that the typical American home may contain gallons of hazardous or toxic liquids? Your students will learn about household products that are potentially hazardous or toxic, and ways to replace them with safer yet effective alternatives.

Activity 10
Finding Safer Substitutes
What's the best way to polish silver? What is tarnish, and how can we remove it safely? Students will learn the answers and find inexpensive, safe and effective ways to replace standard products that may be classified as irritants, corrosives or toxics.

Section 5
Seeing the Whole Picture
By now, your class will have learned about the various pieces of the source reduction puzzle: reducing materials, energy and toxic substances. This section will help students tie these ideas together through the emerging field of Life Cycle Analysis (LCA).

Activity 11
Life Cycle Analysis: Retrace Your Waste
What's the real environmental impact of a fast-food hamburger? Students will learn to see the whole picture by considering the materials and energy it takes to grow, produce and transport all of the ingredients: beef, condiments and packaging. A key learning point is the fact that most waste and pollution occurs before we take that first bite!

Activity 12
Paper or Plastic? A Life Cycle Analysis Perspective
Which of these alternatives reduces waste the most? Students must compare weight and volume, along with energy consumption and the amount of water and airborne pollutants created during the production, transportation and recycling of both. Reuse of bags is also brought into the equation. The results may surprise you.

Section 6
Making a Difference

The time has come for students to apply what they've learned to their everyday lives. These activities will help to reduce waste at school, at home and in the office.

Activity 13
Can We Really Reduce Our Cafeteria Waste?
Do students know how much waste is created in a lunchroom? They'll find out by studying their trash and that of their classmates? They will also develop strategies to reduce the waste.

Activity 14
The Great Paper Waste
More than 550 pounds of paper and paperboard are thrown away each year for every American. In this activity, students will determine what they can do to reduce paper waste, and learn why source reduction is a better solution than recycling.

Activity 15
The Decision Makers
The Governor has asked waste experts (your students) for a comprehensive plan to cut waste. Using what they've learned and the latest EPA data, they must formulate a plan and sell it to the Governor.

IV. Core Curriculum

We don't expect you'll use all the lessons. However, we do have a suggested Core Curriculum of seven activities to ensure subject mastery:

	Activity #
Section 1	1
Section 2	4
Section 3	6 and either 7 or 8
Section 4	9
Section 5	11 or 12
Section 6	Pick one

Feel free to use additional lessons.

V. Glossary

Discards
Items that are thrown away.

EPA
The Environmental Protection Agency. The arm of the Federal government responsible for regulating and protecting the environment.

Hazardous
Harmful to plants and animals.

Landfill
A site where garbage is dumped. Modern landfills are designed to seal in substances so that they can't leak into the environment. When they are filled, landfills can be capped with dirt and grass to become parks or golf courses.

Leachate
Liquids primarily from old dumps that ooze into the ground, possibly contaminating soil and underground water. From the term 'to leach' out.

Municipal Solid Waste
Garbage that is generated by homes and offices. It does not include hazardous or toxic waste.

Pollution
Contamination of air, water and soil usually caused by man-made waste. Pollution is created by burning and various manufacturing processes. (Volcanic gases and ash are examples of natural pollution.)

Recovery
Removing materials from the waste stream so that they can be reused or recycled rather than landfilled or incinerated.

Recycling
A process whereby materials are sorted, cleaned and remanufactured into new products.

Solid Waste Management
The process of controlling waste to minimize both the use of landfills and potential environmental, health and safety problems. Usually referred to as MSW, options include source reduction and composting, reusing, recycling, incineration and landfilling.

Source Reduction
Minimizing the use of materials and energy, thereby also minimizing garbage, pollution and the use or disposal of toxic materials. Sometimes known as waste prevention or pollution prevention.

Toxic
Poisonous, extremely harmful to plants and animals. May cause death.

Waste Generation
The creation of garbage.

Waste Stream
The trail of all garbage items as they move from homes, offices and factories to recycling centers, incinerators and landfills. Think of your household garbage as a small stream. Your stream and those of your neighbors form a bigger stream, which forms a river, etc.

Waste to Energy
The burning of waste to produce energy. Usually, the burning produces steam, which is then used to make electricity. Waste to Energy is sometimes abbreviated as WtE or wte.

VI. Other Statistical Resources

For the latest EPA facts and figures, call your local EPA branch or the main office in Washington and ask for Document # EPA530-R-94-042, Characterization of Municipal Solid Waste in the U.S.–1994. (Note: This document is updated every two years. Ask for the most recent study.)

If you have Internet World Wide Web access, this and related documents are available at:

http://www.epa.gov
Use the search field and enter the letters MSW.

VII. Further Reading

The ULS (Use Less Stuff) Report
For a free subscription, send a self-addressed, stamped envelope to ULS, Box 130116, Ann Arbor, MI 48113. Or look up Use Less Stuff on the Internet: www:http://cygnus-group.com

Choose to Reuse
by Nikki & David Goldbeck, Ceres Press, 1995

In Our Backyard
by Travis Wagner, Van Nostrand Reinhold, 1994

Rubbish! The Archaeology of Garbage
by William Rathje & Cullen Murphy, Harper Perennial, 1992

The Total Package
by Thomas Hine, Little, Brown, 1995

VIII. Materials

All handouts are included with the activities. A few charts will be used throughout this curriculum, including weights and volumes of different types of solid waste. Rather than include them each time they're needed, we decided to source reduce and provide them once. You'll find them at the end of this introduction.

Chart	Title
1	Materials Generated in MSW* by Weight
2	Products Generated in MSW by Weight
3	Management of MSW in U.S.
4	Landfill Volume of Materials in MSW
5	Landfill Volume of Products in MSW
6	Generation of Materials in MSW
7	Materials Recovery and Discards of MSW

**Municipal Solid Waste*

STUDENT HANDOUTS

For easy reference, all handouts are marked with a running head on each page.

Activity 1
What's in Our Trash? Pie Chart Recording Sheet

Activity 2
Site Sheets A,B,C,D,E Artifact Code Sheets
Site Report Sheet, Tally Sheet and
Archaeological Convention

Activity 4
Pie Chart Recording Sheet (see Activity 1)
Where Does the Trash Go? Waste Disposal Chart

Activity 5
Island Survival Sheet and Item List

Activity 6
Properties of a Package Data Tables

Activity 7
Orange Juice Packaging Analysis Worksheet

Activity 8
Coffee Conundrum Worksheet

Activity 9
Classifying Hazardous Household Waste
Data Record

Activity 10
Safer Substitutes Worksheet

Activity 11
Life Cycle Inventory
Life of a Hamburger Poster

Activity 12
Paper or Plastic? Life Cycle Analysis Worksheet

Activity 13
Cafeteria Trash and Waste Observations
Data Table

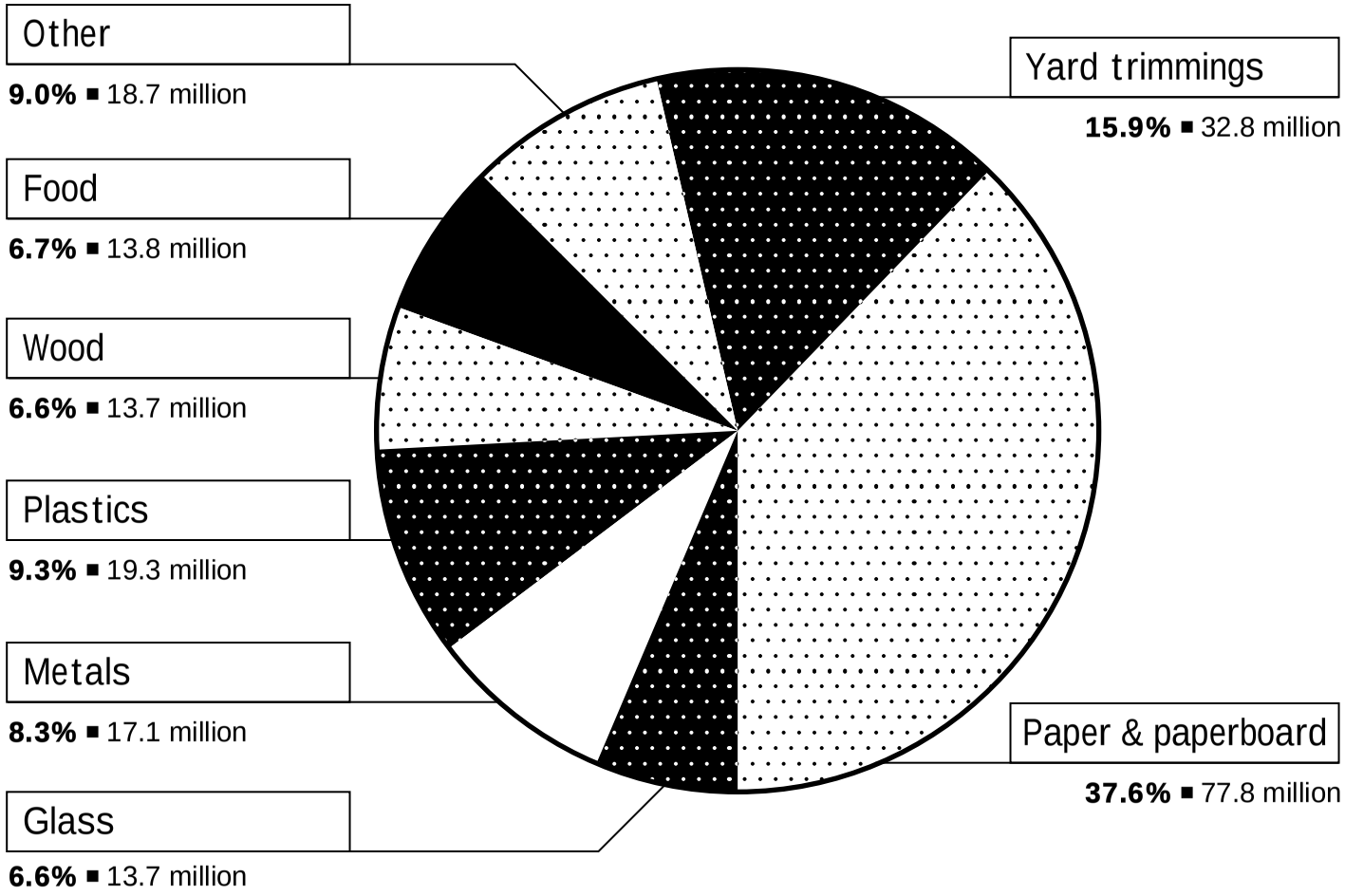
Activity 14
The Great Paper Waste Worksheet

Activity 15
Decision Grid

CHART 1

Materials Generated in MSW by Weight, 1993

Total weight = 206.9 million tons. All figures in tons

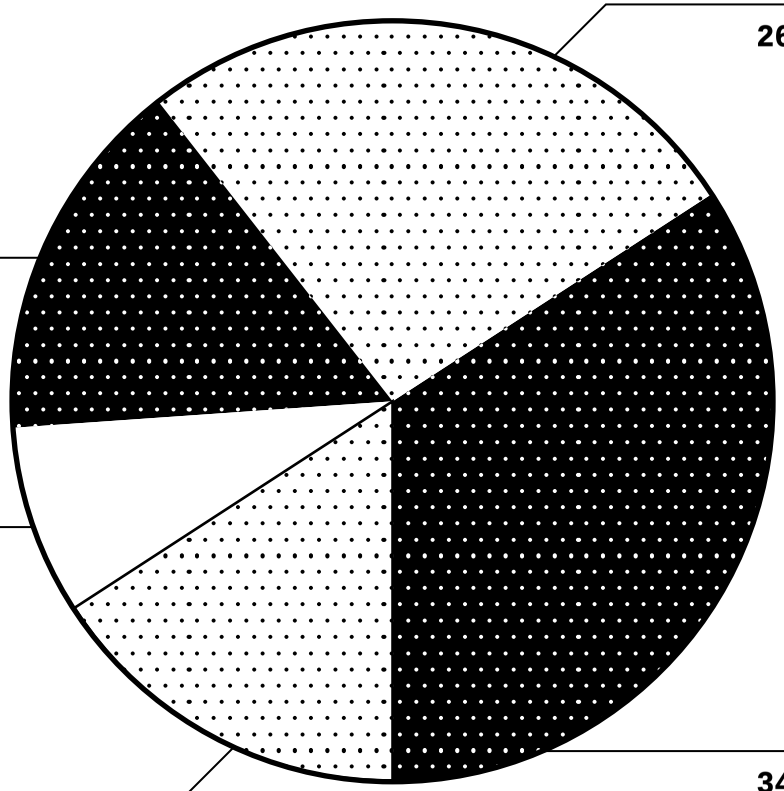


Source: EPA Characterization of Municipal Solid Waste in the US–1994

CHART 2

Products Generated in MSW by Weight, 1993

Total weight = 206.9 million tons. All figures in tons



Nondurable goods
26.5% ■ 54.8 million

Durable goods
15.4% ■ 31.9 million

Food, other
8.2% ■ 16.9 million

Containers and packaging
34.1% ■ 70.6 million

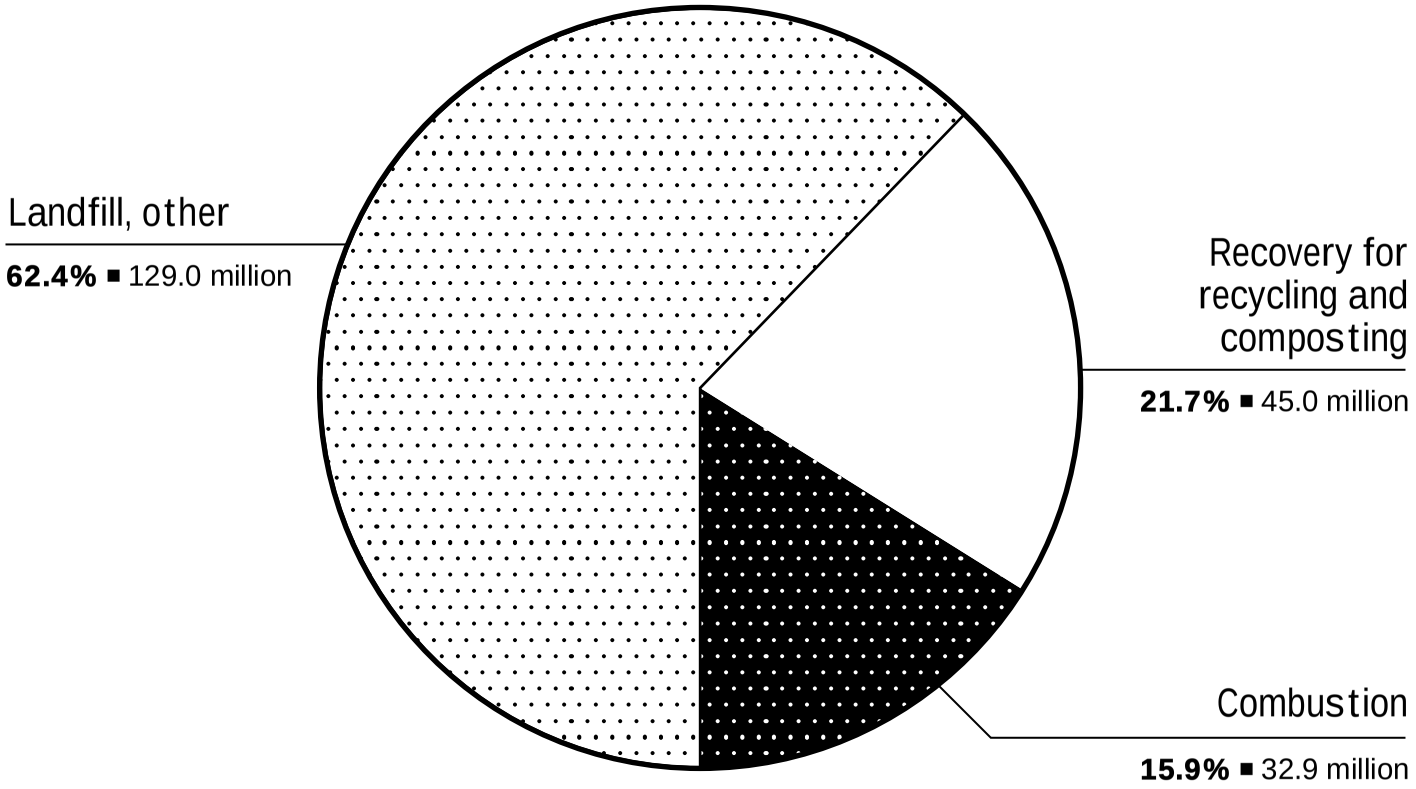
Yard trimmings
15.9% ■ 32.8 million

Source: EPA Characterization of Municipal Solid Waste in the US–1994

CHART 3

Management of MSW in U.S., 1993

Total weight = 206.9 million tons. All figures in tons

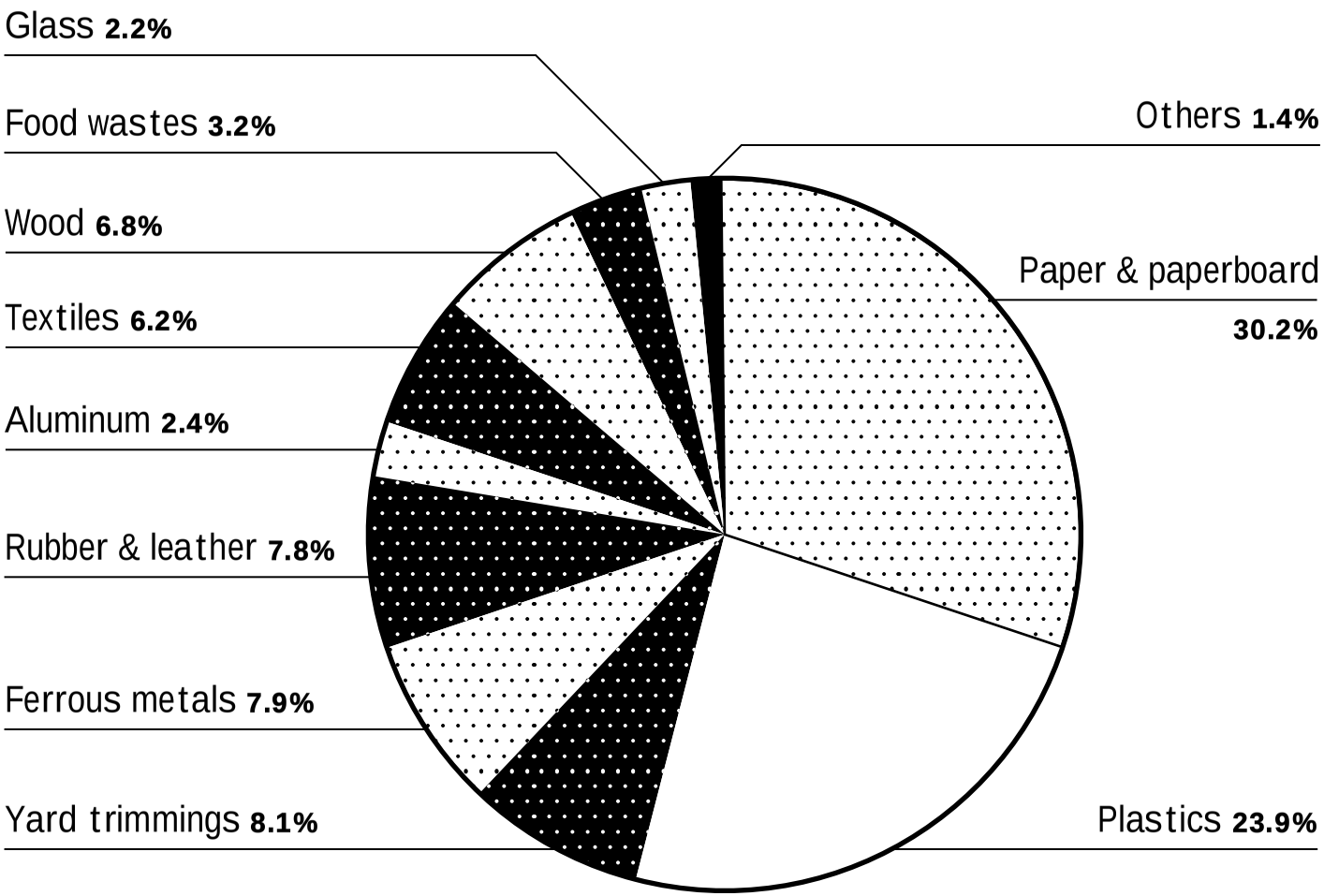


Source: EPA Characterization of Municipal Solid Waste in the US–1994

CHART 4

Landfill Volume of Materials in MSW, 1993

Percent of total volume

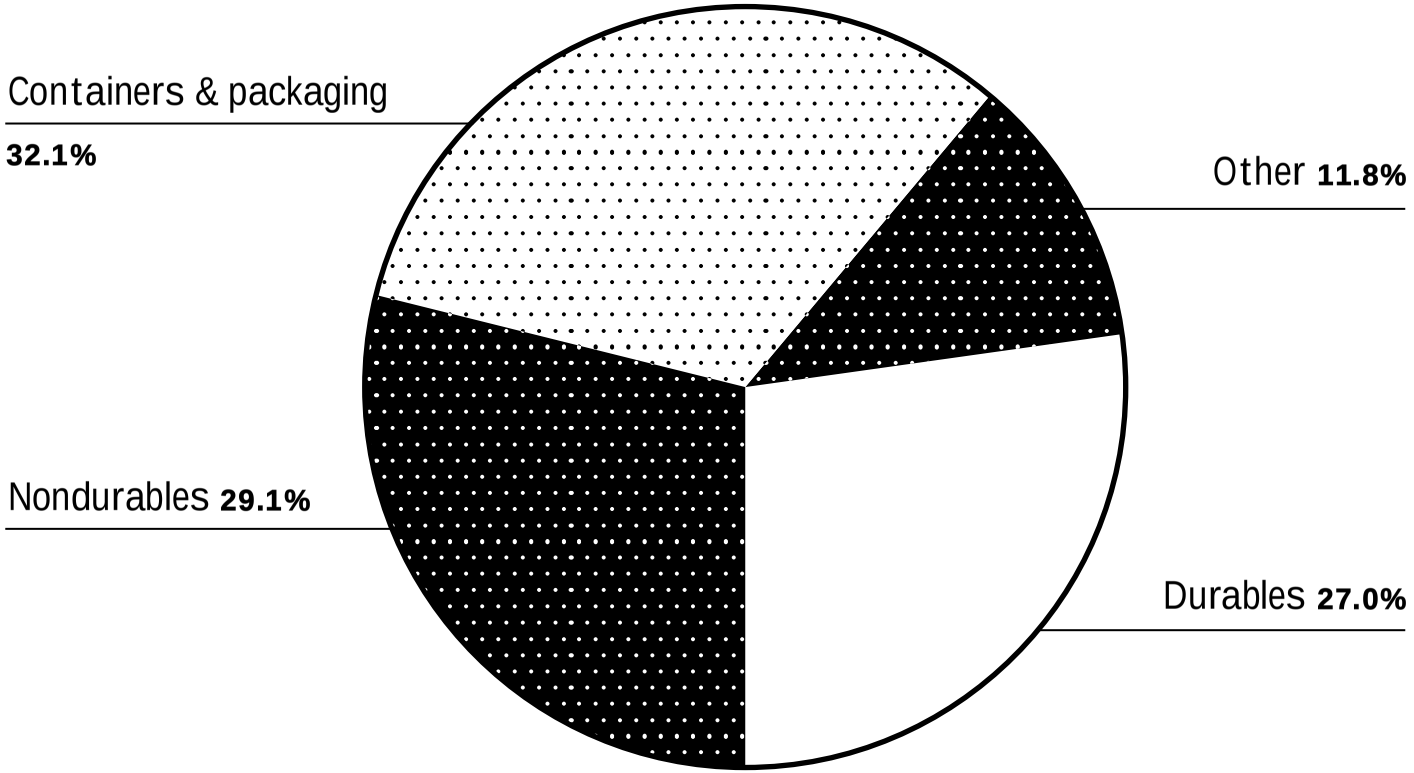


Source: EPA Characterization of Municipal Solid Waste in the US–1994

CHART 5

Landfill Volume of Products in MSW, 1993

Percent of total volume

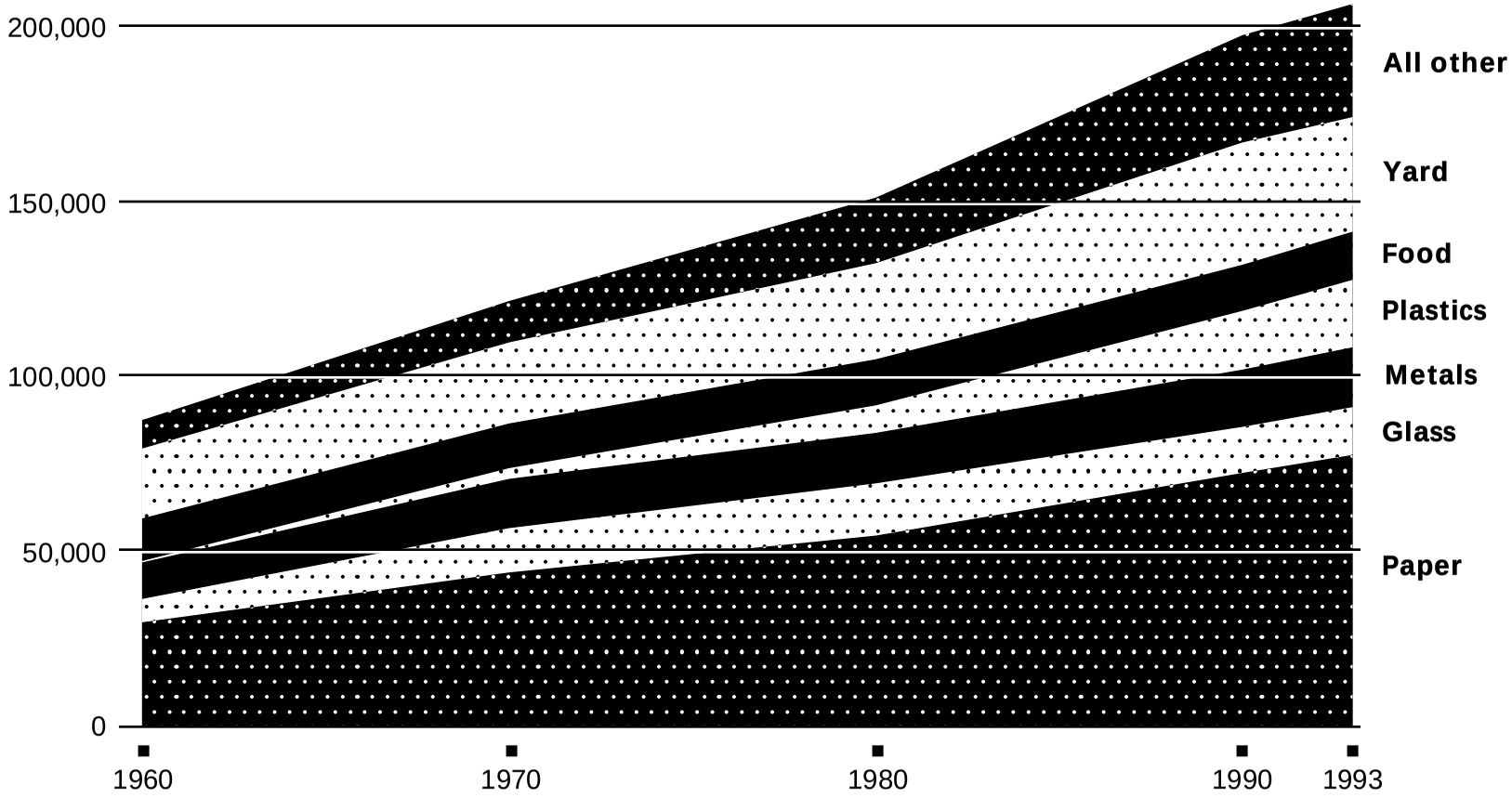


Source: EPA Characterization of Municipal Solid Waste in the US–1994

CHART 6

Generation of Materials in MSW, 1960 to 1993

In thousand tons

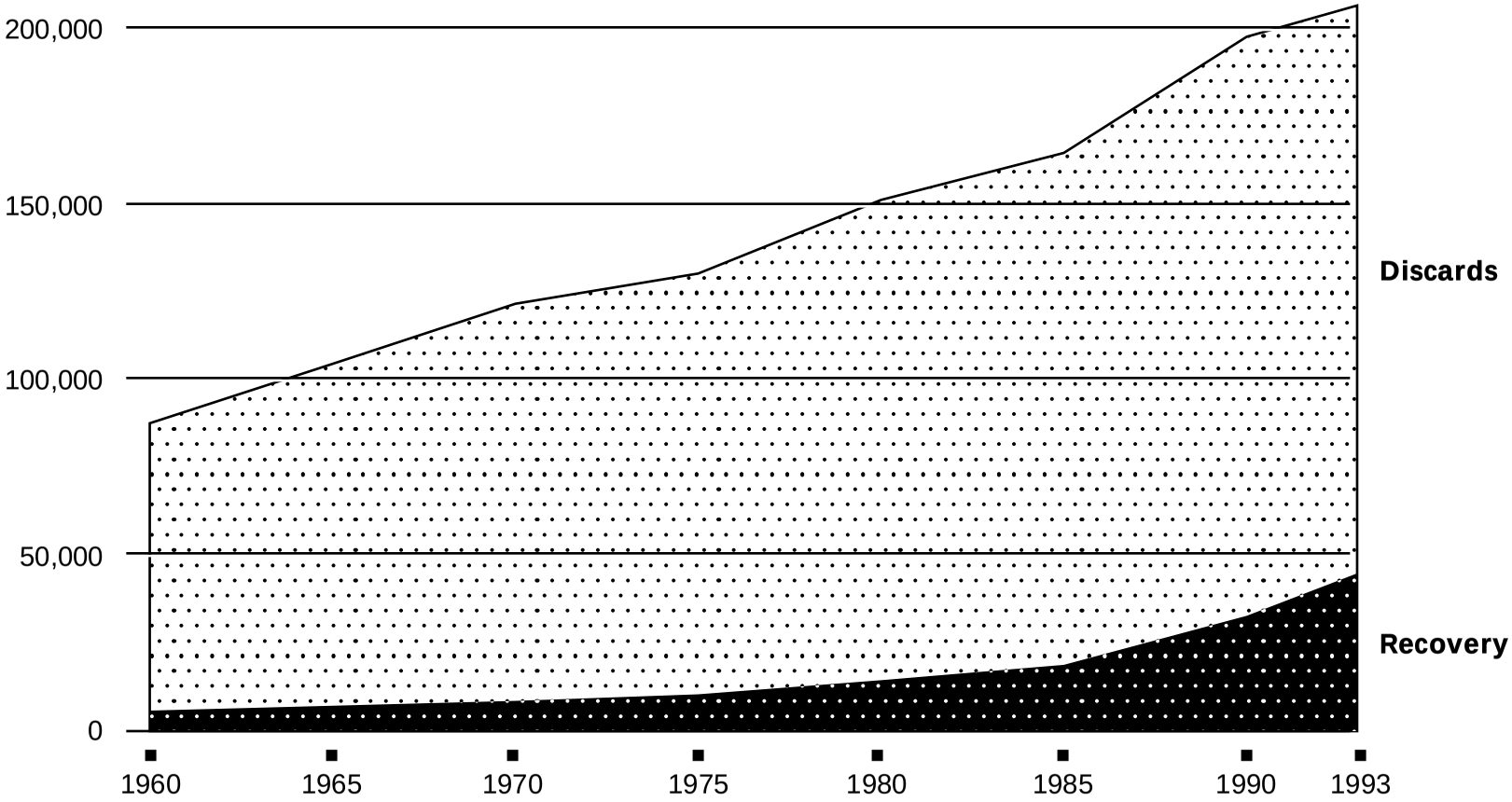


Source: EPA Characterization of Municipal Solid Waste in the US–1994

CHART 7

Materials Recovery and Discards of MSW, 1960 to 1993

In thousands of tons



Source: EPA Characterization of Municipal Solid Waste in the US–1994